Available online www.jsaer.com

Journal of Scientific and Engineering Research, 2021, 8(11):31-37

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Investigation of Changes in Skin Surface and Rectal Temperatures of Anatolian Buffaloes Housed in Different Barn Conditions in Summer Season

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Abstract This research was carried out to investigate the effects of the fogging system applied in summer months on skin surface temperature, rectal temperature and milk yield of Anatolian buffaloes, which were housed in different barn conditions. The study was carried out in a livestock farm located in the Thrace part of Turkey and having a sufficient number of buffaloes. As a result of the research, the average skin surface temperatures of the buffaloes housed in Barn-I, where the fogging system was installed, were lower in the range of 3.2-3.6 ℃ than the buffaloes housed in Barn-II. Similarly, rectal temperature values were found to be lower in the range of 0.2-0.7 ℃ than buffaloes housed in Barn-II. During the research period, the daily average milk yield of buffaloes varied between 3-7 kg in Barn-I, and between 2-5.5 kg in Barn-II. These results will increase the animal welfare and productivity positively by reducing the negative effects of the high temperature likely to occur in the hot summer months of the fogging system to be applied in the buffalo barns.

Keywords Buffalo Barns, Fogging system, Rectal temperature, Milk yield

Introduction

The main purpose of commercial animal breeding is to obtain the highest and most economical yield for a certain cost. This can be possible if the environmental conditions in the barn are kept at an appropriate level together with adequate feeding and appropriate genotype [1]. Environmental conditions include all external factors that affect the growth, development and yield of the animal. These factors can be grouped as climatic, structural, social and other factors [2]. Temperature is the most important environmental factor affecting the physiological activities of animals. For this reason, temperature is the most important factor to be considered among the environmental conditions. Because temperature is a measure of whether the health and comfort of animals can be provided or not. Ambient temperature is more important for buffaloes than for normal cattle. Buffaloes, like other cattle, are from the group of homothermic animals, and their skin contains fewer sweat glands than cattle skin [3]. This situation causes buffaloes to be more sensitive to temperature. Shafie [4] suggests that the ambient temperature of the thermo-neutral zone should be between 2-21 ℃ for buffaloes, and the upper limit value for the physiological thermo-regulator mechanism should be 27 ℃.
The negative effects of high temperatures show themselves in humid regions and especially in summer months. With high environmental temperature, rectal temperature rises, feed and energy consumption and milk yield decrease. The increase in the relative humidity along with the ambient temperature exceeding the normal limits negatively affects the thermoregulation ability of the animal [5].
Body temperature in farm animals is stable and varies within very narrow limits, although there are large changes in ambient temperature. Normal body temperatures vary depending on the species and the way of

rearing, and in farm animals such as cattle, they are approximately between 37-39.3 ℃ limit values. Keeping the body temperature within the mentioned limits is possible by balancing the heat production and heat dissipation from the body [1]. This research was carried out to investigate the effects of fogging system applied in summer months on skin surface temperature, rectal temperature and milk yield of Anatolian buffaloes, which are housed in different barn conditions.

Material and Method

The research was carried out in a livestock farm located in the Thrace part of Turkey with a sufficient number of water buffaloes. The research area is geographically located between 41° 12' north latitude and 28° 44' east longitude, with an average height of 119 m above sea level. According to the meteorological records for many years, the annual average temperature is 13.8 ºC and the annual average relative humidity is 84.5% [6].

In the farm, two groups of 10 were formed by randomly selecting from among the milk buffaloes, which are considered to have the same genetic similarity, with equal lactation numbers and started lactation in the same period. One of the groups was housed in Barn-I conditions, where the fogging system was installed, and the other in Barn-II, in farmer conditions. The same feed rations were applied to both groups. Temperatures inside and outside of the barn were measured continuously during the research with the help of thermohygrometers at 10-minute intervals.

Temperature measurements were made on the skin surfaces of the buffaloes housed in Barn-I and Barn-II every week during the summer months when the research was conducted. Temperature measurements were made at five points, including head, neck, abdominal cavity, anus, and rectal temperature. The measurements were carried out between 05.00 and 08.00 in the morning, between 11.00-13.00 in the afternoon and between 19.00-22.00 in the evening. The data obtained are given as the daily average value. An infrared temperature measuring device was used to measure skin surface temperatures. Rectal temperatures were measured with a digital veterinary thermometer. In addition, daily milk yield records of Anatolian buffaloes included in the research were also kept.

Results and Discussion

Buffaloes are from the group of homothermic animals, and the sweat gland density in the skin of these animals is 1/6 less than that of normal cattle [3]. Due to their physiological characteristics, they are not very tolerant to high temperatures. This situation can cause heat stress if necessary precautions are not taken. When buffaloes are kept indoors, they need cooling, especially in the summer months when temperature stress may occur. For this purpose, it is generally preferred to construct cooling pools in enterprises. The initial investment and operating costs of cooling pools impose a significant financial burden on businesses. In addition, the stagnant water in the pools can cause some negative effects in terms of animal and environmental health over time. In order to eliminate all these problems, it will be healthier and more economical to cool the buffaloes with fogging systems.

In the research, a fogging system was installed in Barn-I, where temperature control will be made. The fogging system is activated automatically when the ambient temperature of the shelter rises to 25 ℃ and above, on the basis of lowering the ambient temperature. For this purpose, a lined fogging system has been set up with a nozzle for each animal for a balanced distribution in the barn. During the study, ambient temperature, skin surface temperature, rectal temperature data of buffaloes and milk yield were measured and recorded in Barn-I and Barn-II. An image of the temperature measurement of the buffalo surface with an infrared thermometer at different points is given in Figure 1, and an image belonging to Barn-I, where the fogging system is installed, is given in Figure 2.

Figure 1: Surface temperature measurement of the skin with an infrared thermometer

Figure 2: Barn-I, where the fogging system was installed

The daily average values calculated from the data obtained from the measurements made in some buffaloes housed in Barn-I are given in Table 1.

Table 1: The daily average values of the measurements made in Barn-I

Months	Measurement time	Out of barn avg. temp(℃)	In-barn avg. temp. (℃)	Buffalo ear no	Average body surface temp. (℃)	Rectal temp. (℃)	Daily avg. milk yield (kg)
				1(12.00)	28.8	37.6	7.0
	1 week	25.6	25.8	2(38.00)	30.4	37.3	6.5
				3(17.85)	29.3	37.4	6.0

June	2. week	18.8	23.6	1(12.00)	28.7	37.4	7.0
				2(38.00)	29.3	37.3	6.0
				3(17.85)	28.1	37.5	6.0
	3. week	26.1	25.6	1(12.00)	29.7	37.4	6.0
				2(38.00)	31.0	37.5	6.0
				3(17.85)	31.5	37.8	5.5
	4. week	26.2	25.2	1(12.00)	30.1	37.7	5.5
				2(38.00)	31.1	37.6	6.0
				3(17.85)	31.5	37.8	5.5
July	1 week	24.9	24.8	1(12.00)	30.9	37.8	5.0
				2(38.00)	31.1	37.8	5.5
				3(17.85)	31.3	37.7	5.0
	2. week	25.2	25.5	1(12.00)	30.3	37.5	4.5
				2(38.00)	30.6	37.9	5.5
				3(17.85)	32.1	37.8	4.5
	3. week	23.7	23.4	1(12.00)	30.7	37.5	4.5
				2(38.00)	30.8	37.5	5.5
				3(17.85)	31.4	37.6	4.5
	4. week	25.2	26.2	1(12.00)	31.4	37.9	4.5
				2(38.00)	31.3	37.5	5.0
				3(17.85)	32.4	37.9	4.0
August	1 week	25.8	27.1	1(12.00)	31.7	37.9	3.5
				2(38.00)	32.1	37.9	4.5
				3(17.85)	32.3	37.7	4.0
	2. week	24.7	27.2	1(12.00)	32.3	38.0	3.5
				2(38.00)	32.5	37.8	4.5
				3(17.85)	32.7	38.2	4.0
	3. week	25.9	25.2	1(12.00)	30.6	37.6	3.0
				2(38.00)	31.2	37.5	4.5
				3(17.85)	31.9	37.6	3.5
	4. week	25.3	25.1	1(12.00)	30.7	37.4	3.0
				2(38.00)	32.2	37.9	4.0
				3(17.85)	32.7	37.9	3.0

When Table 1 is examined, the average daily temperature outside the barn changed between 18.8 and 26.2 ℃, while the average daily temperature inside the barn changed between 23.4 and 27.2 ℃ during the measurement dates in the summer months. In the measurements made at different points of the body surface (head, neck, abdominal cavity and anus) of Anatolian buffaloes on the same dates, the average skin surface temperature varied between 28.1 and 32.7 ℃. In the measurements made with a digital veterinary thermometer from the rectum, the rectal temperature varied between 37.3 and 38.2 ℃. The average daily milk yield of the buffaloes varies between 3-7 kg on the dates of measurement. In addition, the general average values were calculated by using the data obtained from the measurements made in the buffaloes housed in Barn-I and the temperature values of the ambient air inside the barn, and are given graphically in Figure 3.

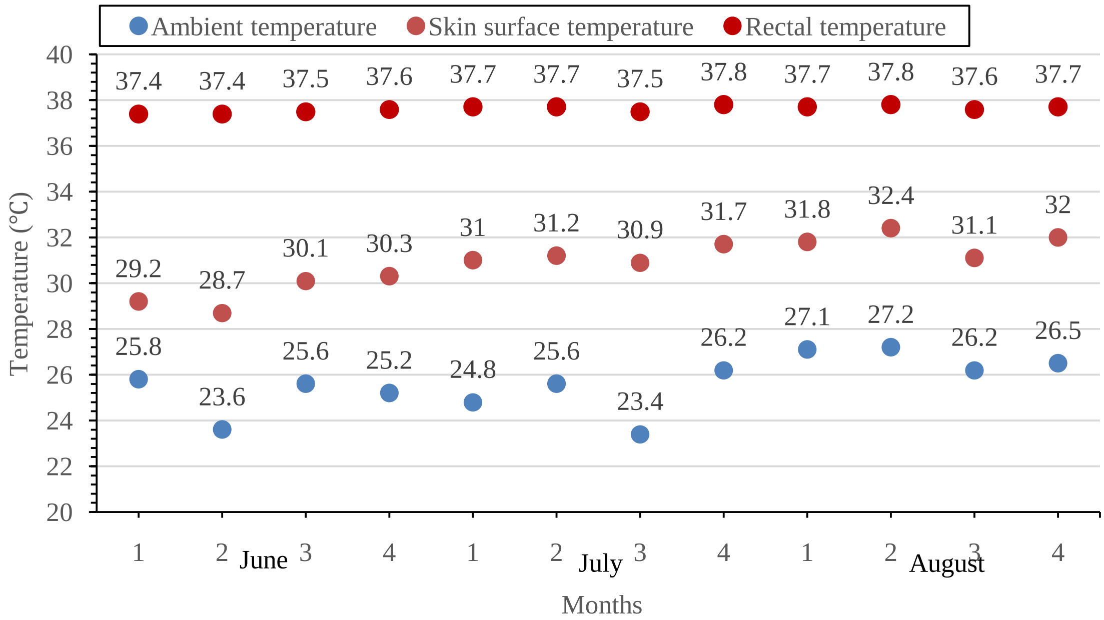

Figure 3: The variation of skin surface temperature and rectal temperature of buffaloes housed in Barn-I depending on the ambient temperature

When Figure 3 is examined, the minimum value of the general average skin surface temperature of the buffaloes housed in Shelter-I is 28.7 °C, and the maximum value is 32.4 °C. The minimum value of the rectal temperature was calculated as 37.4 °C and the maximum value was calculated as 37.8 °C. When Table 1 and Figure 3 are evaluated together, it can be said that there is no temperature stress in the buffaloes housed in Barn-I due to the effect of the fogging system. In other words, buffaloes are kept in a barn with values close to the comfort temperature. Shafie [4] recommends that the ambient temperature of the thermo-neutral zone be between 2-21°C for buffaloes, and an upper limit value of 27 °C for the physiological thermoregulator mechanism. Mutaf [1], on the other hand, states that normal body temperatures vary depending on the species and housing type, and it should be between 37-39.3 °C limit values for farm animals such as cattle.

One of the groups formed in order to make a comparison in the research was housed in Barn-II, where there was no fogging system. The daily average values calculated from the data obtained from the measurements made in some buffaloes housed in Barn-II are given in Table 2.

Table 2: The daily average values of the measurements made in Barn-II

Months	**Measurement time**	**Out of barn avg. temp (°C)**	**In-barn avg. temp. (°C)**	**Buffalo ear no**	**Average body surface temp. (°C)**	**Rectal temp. (°C)**	**Daily avg. milk yield (kg)**
June	1. week	25.6	29.4	1(35.00)	32.9	37.6	5.5
				2(27.44)	32.4	38.3	5.5
				3(12.10)	32.6	38.2	4.5
	2. week	18.8	27.1	1(35.00)	34.7	38.0	5.5
				2(27.44)	32.6	37.9	5.5
				3(12.10)	33.7	38.8	4.0
	3. week	26.1	29.2	1(35.00)	32.7	37.6	5.5
				2(27.44)	34.7	38.3	5.5
				3(12.10)	33.6	38.0	3.5
	4. week	26.2	26.6	1(35.00)	31.3	37.5	5.0
				2(27.44)	31.7	37.6	5.0
				3(12.10)	31.6	37.5	3.5
	1. week	24.9	25.9	1(35.00)	32.3	38.1	5.5
				2(27.44)	32.1	38.2	5.0
				3(12.10)	31.9	38.2	3.5

				1(35.00)	32.2	38.0	5.0
	2. week	25.2	27.1	2(27.44)	32.1	38.5	5.0
July				3(12.10)	31.8	38.1	3.5
				1(35.00)	32.2	37.6	4.5
	3. week	23.7	24.8	2(27.44)	32.0	37.9	4.5
				3(12.10)	31.8	38.1	3.0
				1(35.00)	32.1	38.1	4.5
	4. week	25.2	27.7	2(27.44)	31.9	37.7	4.5
				3(12.10)	31.8	38.0	3.5
				1(35.00)	35.9	38.6	4.5
	1. week	25.8	28.4	2(27.44)	36.3	38.1	4.0
				3(12.10)	35.4	38.9	3.0
				1(35.00)	35.3	38.2	4.0
	2. week	24.7	29.3	2(27.44)	35.7	38.2	4.0
August				3(12.10)	35.1	38.3	3.0
				1(35.00)	36.0	38.8	3.5
	3. week	25.9	28.4	2(27.44)	35.3	38.1	3.5
				3(12.10)	35.9	38.2	2.5
				1(35.00)	34.0	38.2	3.0
	4. week	25.3	26.6	2(27.44)	33.2	38.0	3.0
				3(12.10)	33.9	38.3	2.0

When Table 2 is examined, the average daily temperature inside the barn changed between 24.8 and 29.4 ℃ during the measurement dates in the summer months. When these values are compared with the values calculated for Barn-I, it is seen that they are higher in the range of 1.4-2.2 ℃. The fogging system installed in Barn-I provided cooling by converting the sensible heat in the ambient air into latent heat within the water vapor. In the measurements made at different points of the body surface of buffaloes on the same dates, the average skin surface temperature varied between 31.3 and 36.3 ℃. The mean skin surface temperature of buffaloes housed in Barn-II was between 3.2 and 3.6 ℃ higher than buffaloes housed in Barn-I. Again, when rectal temperatures are examined, it is seen that buffaloes housed in Barn-II are higher in the range of 0.2-0.7 ℃. The average daily milk yield of buffaloes ranges from 2-5.5 kg. As in Barn-I, general average values in Barn-II were calculated and given graphically in Figure 4.

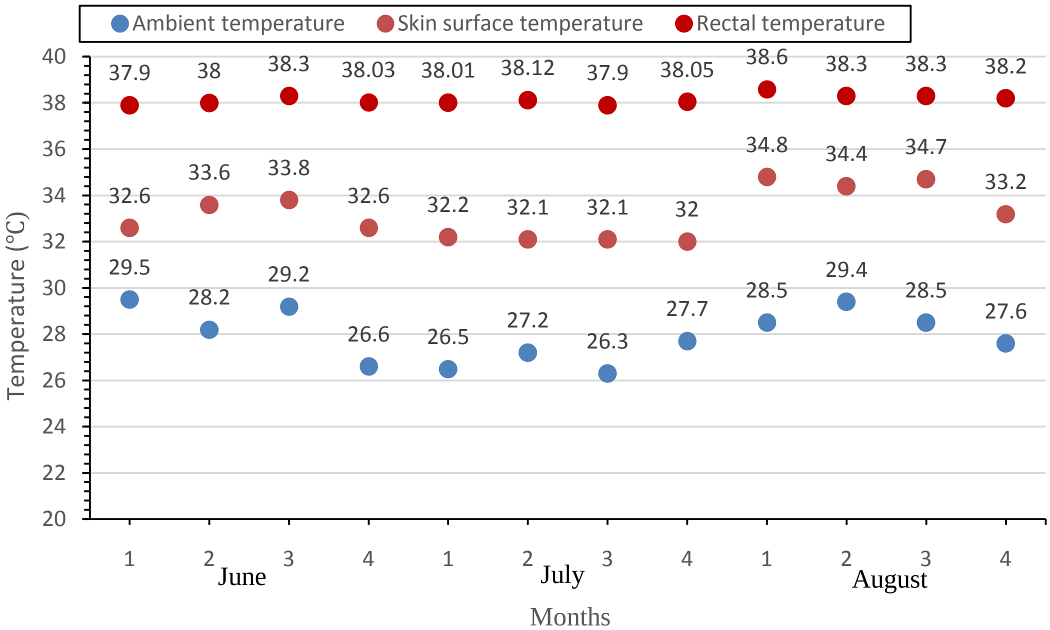

Figure 4: The variation of skin surface temperature and rectal temperature of buffaloes housed in Barn-II depending on the ambient temperature

When Figure 4 is examined, the minimum value of the general average skin surface temperature of the buffaloes housed in Barn-II is 32.1 ℃, and the maximum value is 34.8 ℃. The minimum value of the rectal temperature was calculated as 37.9 ℃ and the maximum value as 38.6 ℃. When Table 2 and Figure 4 are evaluated together, it can be said that the buffaloes housed in Barn-II are under thermal stress compared to the buffaloes housed in Barn-I.

Since the thermal environment in animal barns directly affects the metabolic heat production and efficiency of animals, and indirectly affects their health and comfort, it is the most important factor in increasing the productivity in animal husbandry. The amount of heat and water vapour produced by the animals in the barn varies depending on the temperature and humidity in the indoor environment [7]. For this reason, when the thermal environment control in the barn is not sufficient, effective utilization from the genotypic potential decreases as a result of the negative effect of heat stress and causes yield losses. A well-planned fogging system will be beneficial in reducing the negative effects of heat stress that may occur in buffaloes during extremely hot periods. As Tao and Xin [8] stated, cooling with fogging is done either by spraying high pressure water into the barn to cool the air inside the barn, or by spraying water directly on the animals. As a result of wetting the body surface by spraying water directly on the body surface of the animal, some of the sensible heat is converted into latent heat for the evaporation of the water on the body surface. As a result, heat stress is eliminated.

Conclusion

According to the data obtained as a result of the research, the average skin surface temperature of the buffaloes housed in Barn-II is 3.2 to 3.6 ℃ higher than the buffaloes housed in Barn-I. The rectal temperatures of the buffaloes housed in Barn-II were also higher in the range of 0.2-0.7 ℃ than the buffaloes housed in Barn-I. While the average daily milk yield of buffaloes varied between 3-7 kg in Barn-I, it changed between 2-5.5 kg in Barn-II. These results showed that the fogging system installed in Barn-I is an effective way to increase animal welfare and therefore milk yield by reducing the negative effects of high temperature that may occur in the hot summer months in Anatolian buffaloes.

Acknowledgement

This work contains a part of TOVAG 115O602 project supported by TUBITAK. We are grateful to Presidency of TUBITAK for supporting the project.

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